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Pasadena, California

Atmospheric Infrared Sounder

Changes To AIRS Level 1 Software For V6
Part 1
Overview

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Introduction

- **For V6, both radiometric and spectral calibration improvements are being made**
  - ***Radiometric—Tom Pagano and Margie Weiler***
  - ***Spectral—Larrabee Strow, George Aumann, Scott Hannon, Evan Manning, et. al.***
- **All planned changes are small, and an unchanged L1B remains the primary AIRS radiance product**
  - ***Neither the spectral nor the radiometric changes are significant for weather prediction, but both can be important for climate studies***
- **Changes have been wrapped up into a new Level 1C program and an updated RTA for Level 2**

Outline

- **Rationale for the changes and high-level description**
  - ***Radiometric***
  - ***Spectral***
- **Revised PGE structure at GES DISC**
- **Standalone programs**
- **Following two talks**
  - ***Evan Manning will describe program usage***
  - ***Larrabee Strow will describe technical details***

Radiometric changes (Tom Pagano and Margie Weiler)

- The AIRS absolute radiometric calibration accuracy, and its NIST traceability, were revisited by Tom Pagano in a 2008 SPIE paper
- At Tom's request, Ken Overoye (BAE) and Margie Weiler (retired from BAE, now with ATK) are working on an AIRS absolute calibration paper to be submitted to a peer-reviewed journal
- Margie has extended work by Tom which revises and improves the analysis of the pre-launch data, resulting in an improved set of calibration coefficients

Radiometric changes (cont.)

- **Improvements to the pre-launch analysis**
  - More careful selection of pre-launch test data
  - Fit nadir and -40° data simultaneously to obtain all parameters together
  - Smoothing of space look data made consistent with the present PGE
  - A-side and B-side detectors were treated separately and then recombined at the end to produce a parameter set specific to each AIRS on-board weight table
  - Fits to the polarization parameter were retained—no model adjustments
- **Result is a new fit having lower residuals leading to more accurate radiances, especially off-nadir**

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V6 L1C New Coefficients Have Improved Residuals

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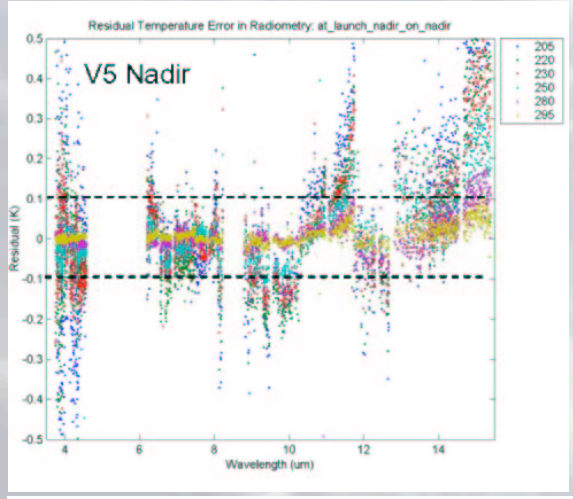
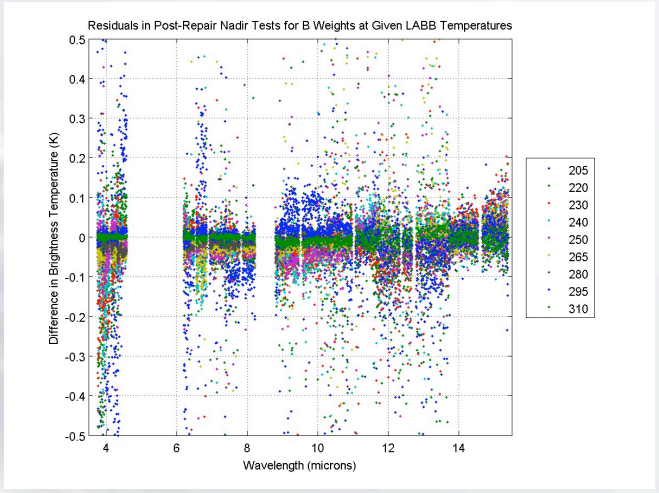
PGE V5

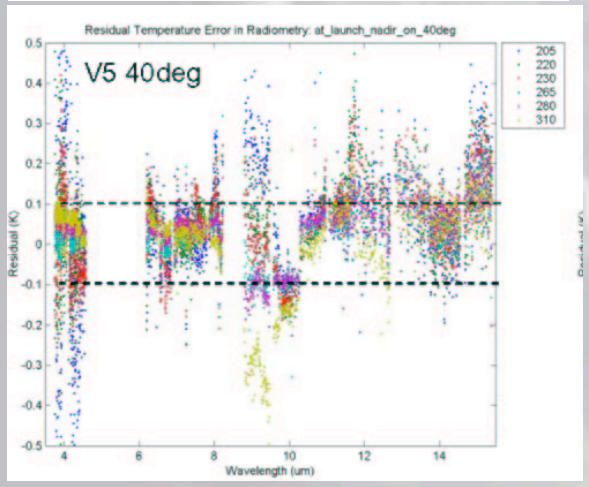
V6 L1C

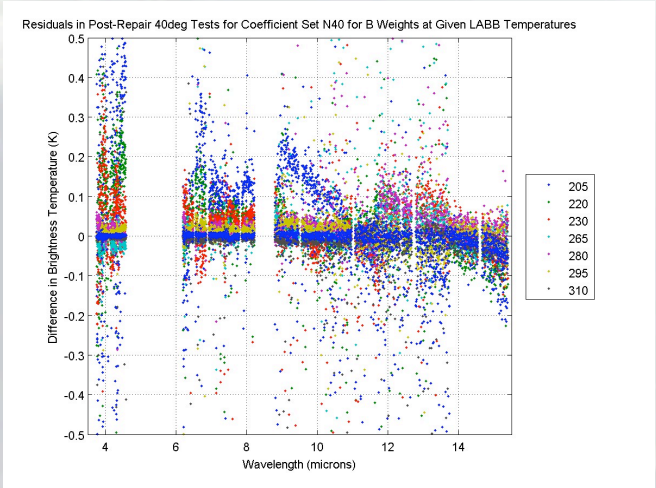
Nadir





-40°





Spectral Calibration Rationale

- **Frequency shifts are very small, but vary on several time scales from orbital to the whole mission**
  - ***Irrelevant for weather forecasting***
  - ***Not important for window channels***
  - ***Significant for climate research for channels on the slopes of lines***
- **The next slide (from George Aumann) shows the typical magnitude of the shifts for channels on slopes of lines**
  - ***Two channels on opposite slopes of a CO_2 line near 790 cm^{-1}***

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AIRS Spectral Shift Example L1B

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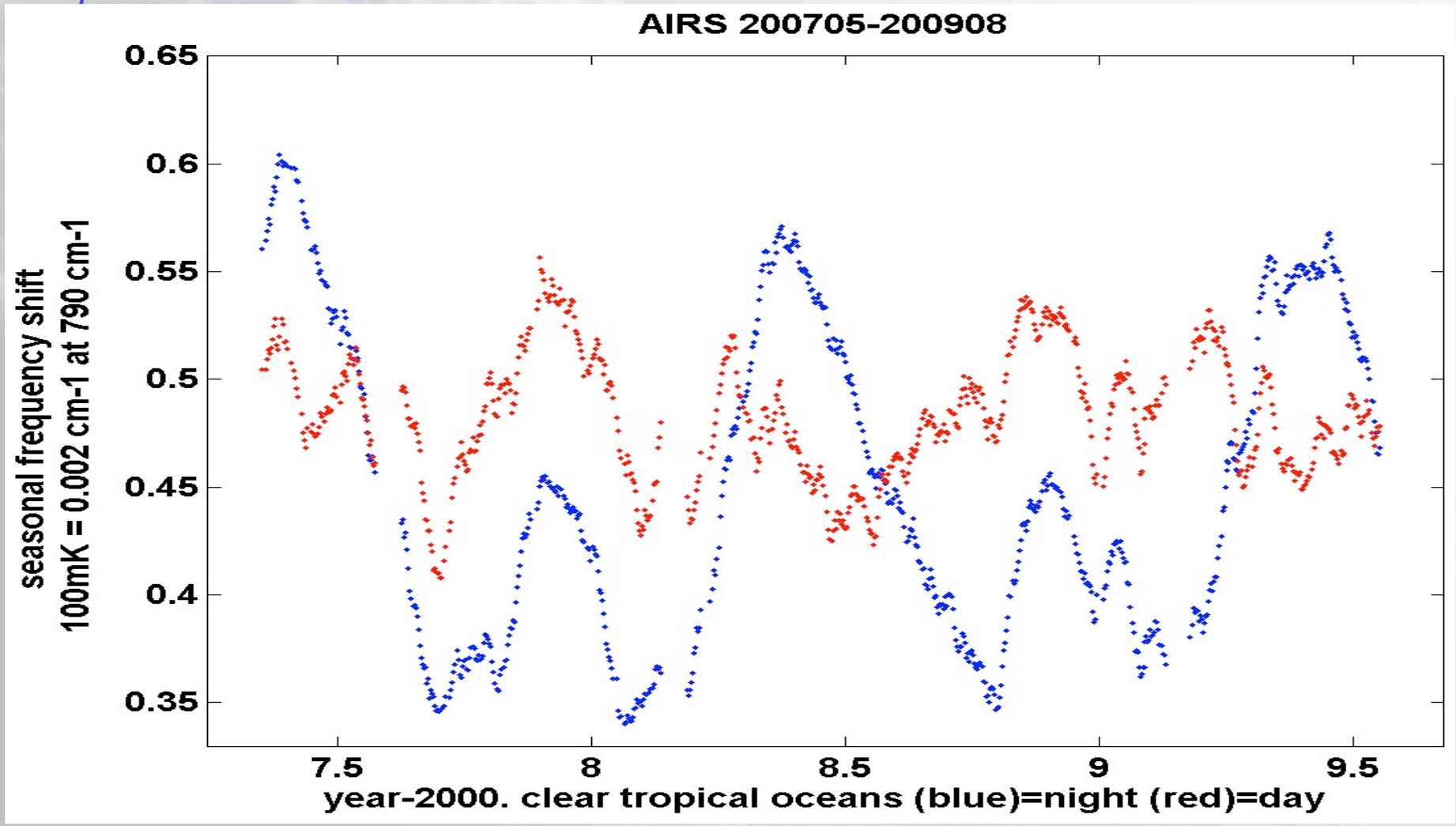

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Same Example For IASI L1C

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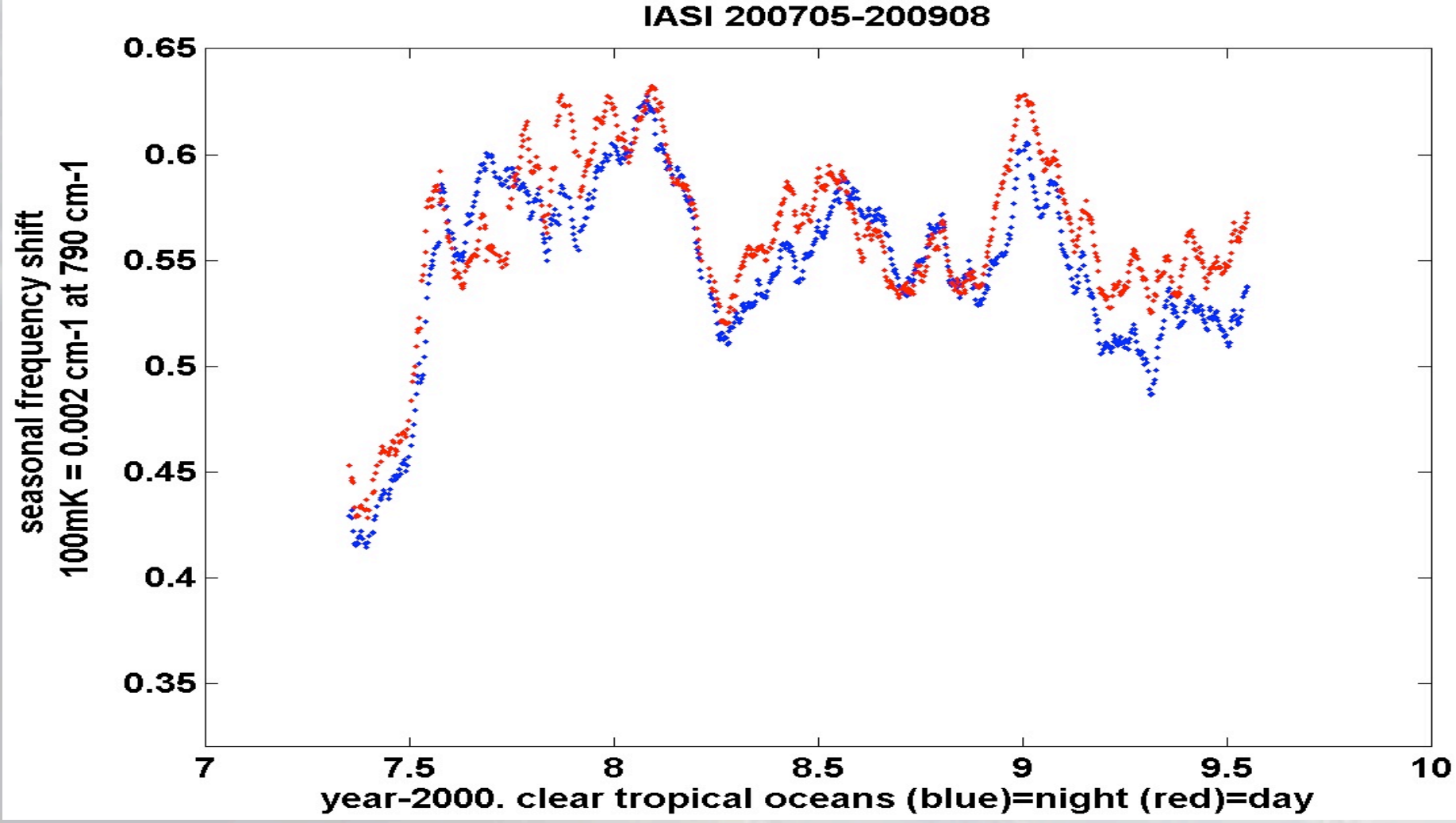

The Spectral Calibration Challenge

- **Produce a Level 1C product which will make George's plot on slide #8 a flat line**

Algorithms

- **Over the last year we have been experimenting with several different algorithms to determine the spectral shift amounts**
  - ***Find correlations between shifts and AIRS engineering parameters***
    - We could not find any combination of instrument parameters which worked reliably
  - ***Measure the shifts dynamically using upwelling radiances (Gaiser/Deen)***
  - ***Use varying gain ratios (assumes image motion along a diagonal so that the shifts in the dispersed and cross-dispersed directions are related) (Manning)***
  - ***Determine the past history of the shifts using (obs – calc) with ECMWF atmospheric states and extend into the future using fits to an analytic expression (Strow/ Hannon)***

Results

- **Evan Manning combined the upwelling radiance technique with the gain ratio technique into a single hybrid algorithm**
- **This hybrid method and the Strow modeling approach give similar results to first order, but differ noticeably when looked at in more detail**
- **Present plan— go with Strow's model**

Level 1C

- **The new Level 1C PGE will:**
  - ***Input radiances from the unmodified L1B***
  - ***Adjust radiances for the changed radiometric calibration coefficients (Pagano & Weiler)***
  - ***Calculate spectral shifts based on time of observation (model by Larrabee Strow)***
  - ***Gap fill and "clean" the spectra (using software developed by Yibo Jiang and described in talks in previous meetings)***
  - ***Resample the spectra to a fixed frequency grid (software also developed by Jiang)***

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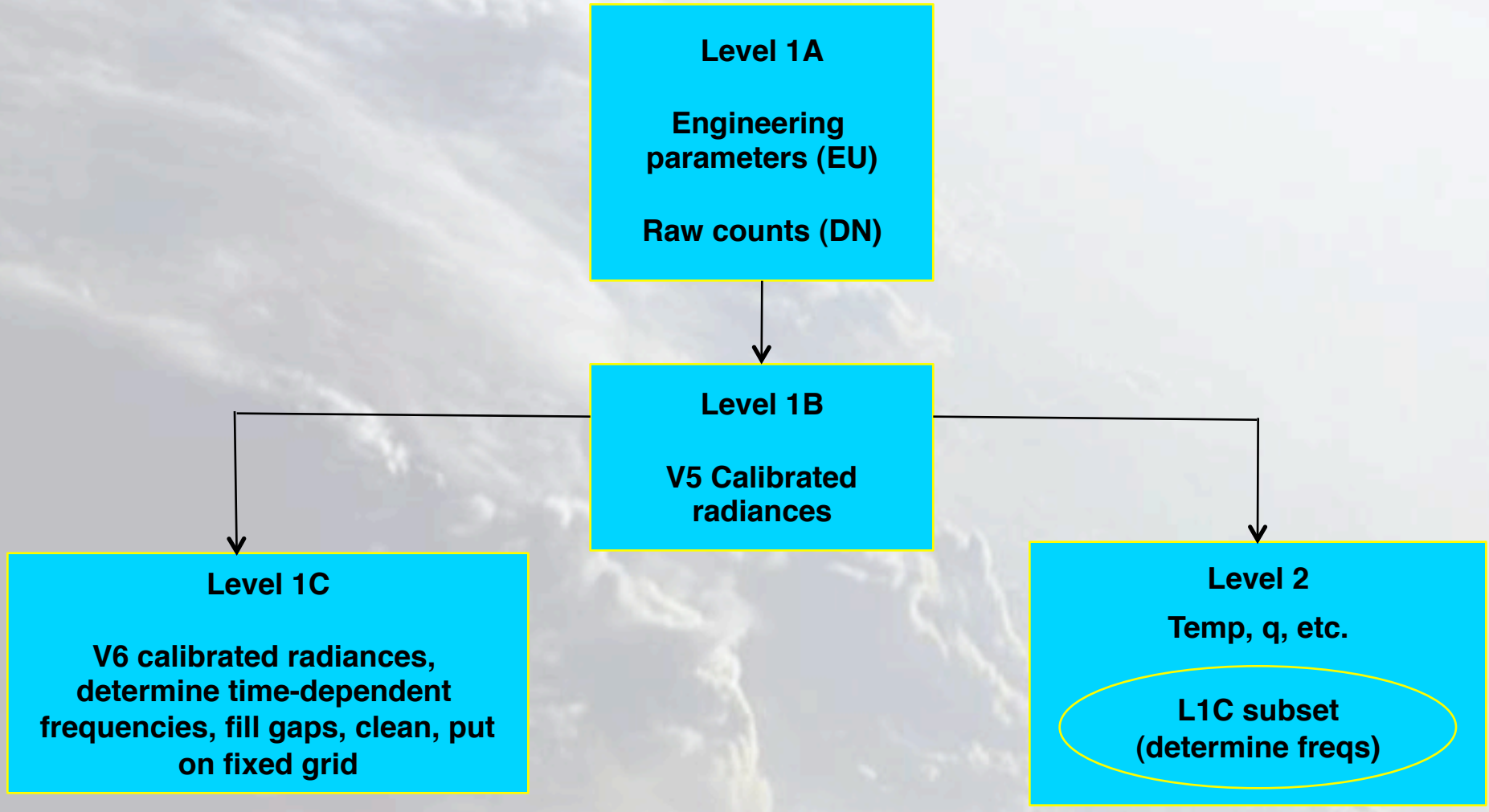
New Level 1 Data Flow



Standalone Programs

- **Frequency shift look up (Strow model)**
- **Frequency shift determination alternate**
  - ***The hybrid Gaiser/Deen/Manning algorithm to determine shifts dynamically from upwelling radiances***
  - ***Will be used as a check at JPL on the Strow model being used in the PGE at the GES DISC***
- **V5 to V6 radiance converter**
  - ***Can be used to convert V5 radiances to the new V6 radiances without running Level 1C***